are therefore a summary in non-mathematical language of the chief methods and results of hydrodynamical theory. They are, on the whole, very clearly written, and present in simple form all the most important points of the theory. The author is not, however, content to follow orthodox theory, but deviates from it in the treatment of several problems. Thus on p. 6 he introduces what he calls the "principle of no momentum," *i.e.* that no resultant momentum can be communicated to a fluid enclosed in a rigid boundary. Against the principle as stated no objection can be taken; but when, as on p. 16, it is applied to the motion of a body in an infinite fluid, it may easily lead to false results.

The second chapter contains an investigation on viscosity and skin friction. This has always been a subject of contention among writers on aërodynamics. Langley and Dines maintain that the tangential force on a plane moving sideways through the air is negligible, less than 0·01 per cent. of the force at normal incidence. Lilienthal, on the other hand, found the tangential force to be between 1 per cent. and 2 per cent. of the force at normal incidence, and therefore at small inclinations it may be comparable with the normal force. Mr. Lanchester, in the second chapter, brings some theoretical considerations to bear on the question, and proves that the force on a plane moving sideways varies as $v^{1\cdot5}$. This result is obtained by supposing the motion laminar, which seems to us quite unjustifiable. In chapter x. an account is given of experiments made on gliders to obtain a value for skin friction. The experiments appear to have been very carefully conducted, and considering the difficulties involved give remarkably consistent results. We hope that the author may be able to extend these experiments and so help to decide this question.

In chapter iv. the author leaves behind the solid ground of orthodox theory altogether, and attempts to work out the motion of a curved lamina or aërofoil. The importance of curved surfaces in flight was first realised by Philipps and Lilienthal. It seems to us that the author is wrong in claiming to be the first to give a theory of the motion of curved surfaces, and that Lilienthal had only a practical acquaintance with the curved form, for Lilienthal clearly realised that the effect of curvature was to diminish the eddy motion and to give an increased upward pressure due to the centrifugal force of the air. The theory has been worked out mathematically by Kutta, and his results are in fair agreement with Lilienthal's experiments. The author of the present volume attempts to work out the problem by applying the theory of cyclic motion to the motion of a surface in two dimensions, but it is difficult to see how this can have any application to the case of a lamina moving in free air. The next chapters contain discussion of various problems connected with flight; many of them are very interesting, but as they turn on the relative value of tangential and normal force, they are, in the present uncertainty as to these values, rather premature.

The last chapter contains an account of the experimental work of Dines and Langley. We could have wished that the author had extended this chapter to include the work of Continental writers such as Lilienthal, Wellner, von Lössl, &c., much of whose work is very valuable, and buried in technical journals which are inaccessible to English readers. Had he done this and excluded some of the more shaky theoretical chapters, the work might without exaggeration be called a complete treatise on aërodynamics.

SPECTROSCOPY.

Handbuch der Spectroscopie. By H. Kayser. Vol. iv. Pp. xix+1248. (Leipzig: S. Hirzel, 1908.) Price 72 marks.

THE amount of material available on the general phenomena of absorption is well known to everyone who has interested himself in this branch of science, and it is impossible to withhold admiration for the manner in which the subject is treated in the present volume. It is not easy in a short notice to discuss in detail the merits or demerits of so varied a chapter of contents as we have before us, but a brief glance will serve to show the lines followed by the author.

Whereas in the latter portion of the third volume there was given a list of compounds of known constitution, together with their absorption spectra, the first three chapters of the present volume contain an account of the absorption of colouring matters as obtained from plant, human, and animal sources. Any possible criticism of the expediency of inserting these chapters is somewhat disarmed at the outset by Prof. Kayser's preface. He was himself somewhat doubtful at first, but concluded that it would be intolerable that a book on spectroscopy should pass over these most important substances in silence. At the same time, there is no doubt that much of the work that has been published on these colouring matters is worthless; indeed, these chapters serve to show how chaotic and uncoordinated are the results of investigators in these fields.

The fourth chapter, which is from the pen of Dr. A. Pfluger, deals with dispersion, or, rather, anomalous dispersion. Herein is to be found a fine critical review of the experimental and theoretical work on the relation between dispersion and absorption.

The next two chapters, which are each about 270 pages long, deal with phosphorescence and fluorescence, the latter being contributed by Dr. H. Konen. The division of the phenomena under the two heads is based upon the criterion that phosphorescence persists for a finite time after the exciting cause has been removed. The chapter on phosphorescence, commencing with an historical account of the subject, deals in succession with the various means of excitation and the experimental methods, the influence of temperature, the spectroscopic investigation of phosphorescence, and finally the theories of the *underlying* phenomena. This chapter contains a very full account of all the work which has been carried out, and will, indeed, prove very valuable. The literature is very scattered, and this is the first time that a reasoned attempt has been made to collect and correlate the somewhat discordant details of experimental research in the domain of phosphorescence.

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Dr. Konen's chapter on fluorescence is again admirable, and is also prefaced with an historical section, from which may be gathered the interesting information that the first mention of fluorescence is an account which Robert Boyle found in a Spanish manuscript dated 1570 of an aqueous extract of some wood.

The second section of this chapter deals with the so-called bright-line fluorescence spectra, including, of course, the work on iodine and Prof. R. W. Wood's new work on sodium vapour. This opens the question as to what is meant by fluorescence, for it would seem that the phenomena of bright-line spectra obtained with iodine and sodium vapours are of a different order from the true fluorescence of organic compounds. Wood's more recent work would certainly go far to show that his results are those of optical resonance pure and simple. On the other hand, the real fluorescent phenomena of organic chemistry are of a very different nature. They are undoubtedly due to a certain complexity of structure; they undoubtedly require a linking together within the molecule of a definite number of centres of unsaturation (used in the chemical sense). Conversely, a simplification of the molecular structure tends to decrease the power to fluoresce. The two phenomena must therefore be of different type, and for this reason it would be preferable to treat the bright-line phenomena under a separate heading of resonance spectra, leaving the term fluorescence to the more complicated molecular phenomena of organic chemistry.

Following on the section upon bright-line fluorescence there are sections dealing with ordinary band fluorescence spectra, the method of investigation, the absorption and emission of fluorescing substances, the influence of temperature, of the solvent, and of the wave-length of the exciting light, and, finally, two sections dealing with the relation between fluorescence and chemical constitution, and also with general theories. A list of substances is added which are known to exhibit fluorescence, a list which, though far from complete, is a very useful addendum. This list brings to conclusion a volume which is a worthy follower of the three volumes which have preceded it.

POPULAR ORNITHOLOGY.

(1) *A Bird Collector's Medley.* By E. C. Arnold. Pp. iv+144; with 12 coloured and 8 collotype plates and illustrations in the text. (London: West, Newman and Co., 1907.) Price 10*s*.

(2) *Birds of Britain.* By J. Lewis Bonhote. Pp. x+405; with 100 illustrations in colour. (London: Adam and Charles Black, 1907.) Price 20*s*. net.

(3) *A Book of Birds.* By W. P. Pycraft. Pp. viii+155; with 30 full-page coloured plates and illustrations in the text. (London: Sidney Appleton, 1908.) Price 6*s*. net.

(1) MR. ARNOLD has been known for several years past in the bird world as an enthusiastic shore-shooter who has been lucky enough in recent years to secure examples of several migratory birds which have very rarely been known to straggle to these shores, and, indeed, to add two species to the British list. He very ably justifies the killing of these rare migrants on the grounds that they are abnormal wanderers which would never settle in England, and adds that it seems far better that they should be carefully preserved for the benefit of those who would otherwise never see them rather than be observed through glasses by one individual for the space of perhaps half an hour at the outside. His introductory chapter is mainly taken up by a forcible defence of the amateur collector, who, he very truly says, is abused by books, periodicals, newspapers, and those very ladies who adorn their bonnets with stuffed terns and bullfinches. What is more contemptible is the attitude of "some eminent naturalist, who has possibly amassed a fine private collection in his youth, and has now taken up the fashionable cry." We were reminded of the truth of this "reprisal" upon reading quite recently a review of this very book. A chapter on bird-protection deserves careful perusal. It is an able summary of the whole matter, so far as it concerns this country, and contains more common-sense and less rubbish (we had almost written hypocrisy) than any other disquisition on the subject we have met with for a long time. For the rest, the book is chiefly an account of the author's personal experience as a field ornithologist and collector in many and varied parts of the British Islands, and contains many very interesting notes and observations.

One of the best chapters relates the experience of a dunlin, born on the fells, going down to the seashore for the winter and back to the moorlands in spring, and is very well told indeed (in the dunlin's own words). There is also a good chapter on bird-stuffing, and a medley was a good name for the book. The twenty full-page plates, the work of the author, portray some pleasing scenes in bird-life. Some also are intended to recall specimens of rare birds in the author's bird collection in the Eastbourne Institute. No one would wish to criticise their merits too closely; it is enough that for the most part they appeal to the emotions of the field ornithologist.

We must protest, however, against the plate of the two ruffs in full breeding dress fighting at their breeding grounds. Anyone who has watched ruffs on the "hill" must have been struck especially with one circumstance, viz. the great diversity in colour of the birds, and that from perhaps a dozen or so collected on the hill at one time it would be impossible to pick out two the colours and arrangement of colours of which were alike. We cannot, therefore, but regard the present picture displaying only two ruffs, and those practically as alike as two peas, as unnatural. For although such a case is not, of course, absolutely impossible, it is extremely unlikely. The various illustrations in the text are from photographs, and some of them, *e.g.* "Doing the Bushes," will recall days spent in that now famous spot to the minds of many birdmen. The addition of an index would have been an improvement to this nicely-got-up volume.

(2) Messrs. Adam and Charles Black have added to their series of beautiful books, with full-page illustrations in colour, a volume on "Birds of Britain." The

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